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ABSTRACT

Assessment is an integral part of the systemic reform of the educational process. This pamphlet seeks to reflect a vision for student assessment that will engage students, teachers, parents, policymakers, and the public in progress toward attainment of the National Educational Goal of U.S. students being the first in the world in science and mathematics achievement by the year 2000. Assessment should begin with identifying the purpose and context in which the assessment is to be used, type of information sought and the use to which the information will be put and should be aligned with rigorous and challenging content standards of what students should know and be able to do. Many different methods should be used to ensure that all students have the opportunity to be challenged by assessment. Teachers must be actively involved in the entire assessment process. The community must understand the assessment process and be aware of assessment results. State, national, and international aspects of assessment are discussed. The three central issues at any level are: (1) what students should learn, (2) how they should be taught, and (3) how progress should be measured. An effective assessment should provide information that can be used to improve students' access to mathematical and scientific knowledge and to help each student prepare to function effectively in today's society. (Contains 7 references.) (SLD)

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Statement of Principles on Assessment in Mathematics and Science Education

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STATEMENT OF PRINCIPLES ON ASSESSMENT IN MATHEMATICS AND SCIENCE EDUCATION

"By the year 2000, U.S. students will be first in the world in science and mathematics achievement."

National Education Goal

In order for the Nation to achieve its education goals, educators and policymakers should consider the following guidelines in their efforts to improve student assessment:

- unite instruction, curriculum, and assessment to support each other;
- make assessment contribute to the learning of *all* students;
- include varied assessment approaches; and
- focus more attention on interpretations and uses of student assessment.

Assessment is an integral part of systemic reform of the educational process. This document seeks to reflect a vision for student assessment that will engage students, teachers, parents, policymakers, and the public in our progress toward attainment of the National Educational Goal. It is in this spirit that the U.S. Department of Education and the National Science Foundation wish to cooperate and support efforts in this complicated but critical endeavor. Moreover, this document will serve as a guide for planning and implementing the improvement of student assessment in the critical areas of mathematics and science.

ASSESSMENT IN MATHEMATICS AND SCIENCE

Educators and others use assessments for a variety of reasons. Such reasons include the desire to measure student learning, to identify areas of difficulty for individual students, to provide opportunity for students to apply their problem solving skills, to plan instructional strategies, and to provide evidence of the effectiveness or impact of an educational program. No single assessment instrument can accomplish all of these tasks. Multiple instruments are needed.

It should be said at the outset that a comprehensive portrait of achievement by American students in science and mathematics requires input from all levels. These include the classroom, school, State, Nation, and the world. Cooperation, therefore, between constituencies at all levels is essential.

Student assessment at each level brings with it a unique set of issues, complexities, and reasons for assessing students. Nonetheless, some principles apply to student assessment at any level. First, ***effective assessment should begin with identifying the purpose and context in which the assessment is to be used, the type of information sought, and the use to which the information will be put.*** Assessment instruments designed for specific purposes should vary; most often, an *assessment program* should include the application of a variety of assessment instruments.

Second, ***an assessment program at every level should be aligned with rigorous and challenging content standards of what students should know and be able to do.*** In this document, standards include content and performance standards, benchmarks, and principles or guidelines that provide a vision of what we want students at the elementary and secondary levels to know and be able to do in mathematics and science. The standards may be developed at the local, district, State, and national levels. At each level, these standards should be developed with the strong support and involvement of content experts and

key constituencies. Some current references to such standards appear at the end of this document.

Assessments at the national level may not be consistent with all aspects of every State's content standards, since standards in different States may not be consistent with each other. Similarly, international assessments may not be aligned with all national goals among different nations. Nevertheless, assessments at the national and international levels should support and align with these goals when possible and where appropriate.

In addition to these two fundamental principles, an assessment program at each level should

- assess student knowledge and understanding of mathematics and science in ways that are more complex and demanding than traditional tests, by including the assessment of higher order thinking skills and problem-solving ability;
- be valid, reliable, and fair;
- be based on knowledge of how students learn and develop;
- be implemented in such a way that each assessment instrument is used and interpreted only for the purpose for which it was intended and in a context where that purpose is clear to all groups involved in the assessment and use of its results;
- use assessment results in the process of improving instruction strategies and curriculum development; and
- promote equity by providing each student optimal opportunity to demonstrate mathematical and scientific knowledge and skills.

ASSESSMENT FOR STUDENTS

When appropriately and effectively applied, student assessment measures what we value. Many different methods of assessment should be used to assure that all students--those with various abilities, backgrounds, and levels of English language proficiency--have ample opportunity to be challenged by assessment. Moreover, assessment should be an integral part of the learning process, not the end result. An assessment program for students should

- be coherent and comprehensive;
- be equitable and engage *all* students;
- be integrated with instructional strategies and curriculum materials to promote effective student learning; and
- provide information that will help yield valid inferences about students' learning.

TEACHERS AND ASSESSMENT

Teachers must be actively involved in the entire assessment process if learning, instruction, and assessment are to become integrated in the classroom. Teachers need *training, time, and support* to be able to

- understand the variety of assessment designs and strategies as well as the strengths, applications, and limitations of each assessment instrument;
- have effective instruments for each assessment purpose;
- assess students informally and frequently;
- make sound judgments of individual student achievement based on the results of assessments; and

- report student progress to students, parents, and administrators in a timely and meaningful way.

SCHOOLS, COMMUNITIES, AND ASSESSMENT

A school uses student assessment in a variety of ways. Some student assessments are geared to measuring individual student achievement. Others are used to evaluate the effectiveness of the school's programs in light of local, regional, or State expectations. It is important to report on the effectiveness of the school's programs to students, teachers, parents, school boards, other policymakers, and the community at large. Because statistical data and changes in assessment techniques left unexplained often can be confusing, such aspects of the assessment process should be open to review and scrutiny.

To provide effective assessment of the school's programs for the community and clear understanding of the results of assessment, the school should

- align classroom student assessment with adopted school curricula and educational objectives for students;
- make clear to both students and parents what assessment instruments are measuring when they are applied;
- facilitate public, and, in particular, parental understanding of the variety of assessment techniques being used in the schools; and
- ensure that student progress is reported to parents, and that the school's performance is reported to the community in an open and meaningful manner.

ASSESSMENT AT THE STATE LEVEL

Most States have established ambitious and rigorous objectives or frameworks in mathematics and science education. State-level assessment should provide a common measure of student achievement throughout the State. Often, such testing is used to hold schools accountable for the resources they have received. For this reason and other such reasons, it is important that all parties involved in such assessment are aware of the issues relating to ***measurement-driven instruction***. It is necessary to understand the effects on the educational objectives, curriculum, and instruction that can occur which are motivated by the consequences, or stakes, attached to assessment results.

In addition to providing a common measure of student achievement, State-level assessment should enable educators to track progress toward achieving State content standards. It should also allow them to measure the quality of science and mathematics education by geographic area, community types, race and gender, and program offerings. A student assessment program at the State level should

- support the collective educational precepts and reform efforts adopted by its communities;
- provide a comparative dimension for analysis among the several demographic factors; and
- report findings in an open and meaningful manner.

ASSESSMENT AT THE NATIONAL LEVEL

Reasons for assessment at the national level parallel reasons for assessment at the State level. Such assessment provides educators, policymakers, and other interested citizens with information about student achievement in mathematics and

science on a broad scale. National-level assessment also helps us gauge our progress toward meeting the National Education Goals. Moreover, it should help inform us about the relevance and adequacy of current national standards. Finally, it should help individual States gauge the progress of their students in comparison to the Nation as a whole.

We should use national resources to develop innovative approaches in assessment. These approaches might then be applied at the State and local levels.

In addition, assessment at the national level should focus on identifying demographic factors that influence learning as well as factors that can be changed to improve learning. Consistent with efforts in the preceding categories, a national assessment program should

- support the educational precepts adopted by the mathematics and science communities in the Nation;
- remain flexible and reflect changes as these educational standards change;
- use innovative approaches to measure achievement by applying new methods and technologies in student assessment; and
- report findings in an open and meaningful manner.

ASSESSMENT AT THE INTERNATIONAL LEVEL

Educational effectiveness has become a strategic policy issue for nations in today's global economy. For this reason, it has become very important for nations to know more about the mathematical and scientific knowledge and performance of their students. Student assessment spanning several nations should allow for comparisons of student achievement among the nations. It should also

allow for the identification and analysis of a wider range of factors that may affect student learning than is possible otherwise. For example, factors such as the length of the school year and school-entry age are fairly constant in the United States. These factors are not international constants, however. Assessment at the international level should

- assist in the identification of factors, difficult to detect on a narrower scale, that may be modified in order to improve mathematics and science;
- gauge the progress of American students against that of students in other countries; and
- provide results in an open and meaningful manner.

CONCLUSION

Educational reform revolves around three central issues: what students should learn, how they should be taught, and how progress should be measured.

Curriculum, instruction, and assessment must mutually support one another in the educational process, with each serving common goals and high standards. Assessment, in particular, must cease to be an independent function designed principally for the efficiency and economy of administration. Instead, educators should use it to measure all facets of curriculum and consider its contribution to students' learning.

In mathematics and science, the new and broader aims of assessment can be captured in three broad educational principles, as defined by the Mathematical Sciences Education Board's publication entitled *Measuring What Counts*:

1. **The Content Principle:** Assessment should reflect the mathematics and sciences that are most important for students to learn.

2. **The Learning Principle:** Assessment should support good instructional practices and enhance learning.

3. **The Equity Principle:** Assessment should support every student's opportunity to learn important mathematics and science.

These three principles place special demands on assessment reform at the classroom, school, district, State, and national levels if assessment is to be interwoven into the fabric of educational reform. An effective assessment should provide information that can be used to improve students' access to mathematical and scientific knowledge and to help each student prepare to function effectively in our complex and changing society.

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